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On a Cephaline Gregarine from *Otocryptops*
rubiginosus Koch

With 18 Text-figures

Tosito HUKUI

Biological Laboratory, Hukuoka Gakuhei University

(Communicated by Y. OZAKI)

INTRODUCTION

During a study of the gregarines which are harboured in the alimentary tract of Chilopoda, I found a species, very variable in body-shape and especially in the structure of the epimerite. After continual observations recently I have been able to make out clearly the changes which take place in the development of this parasite. This species exhibits a number of unique features and is distinguishable from the known species as set forth in the following description.

I wish to thank to Mr. Eizi Isimatu and Mr. Morikuni Simai who afforded me the facilities for collecting the materials. I am deeply grateful to Prof. Dr. Y. K. Hiraiwa, Prof. Dr. I. Miyazaki, Dr. S. Miyake, and Mr. Y. Yamakawa, the Head official of the Central Library of the Medical Department of Kyusyu University, who afforded me the opportunity of reading the literature. To Dr. Y. Ozaki, Prof. of Hiroshima University, I express my most hearty appreciation for his unfailing interest, and for his valuable suggestion and criticisms.

MATERIAL AND METHOD

The smears were fixed in Schaudinn's or Bouin's fluid, and stained with Heidenhain's iron haematoxylin, neutral red, or methylene blue. Observations of living specimens were also made.

Hoplorhynchus ozakii sp. nov.

(1) Cephalont.

In the young stage, epimerite simple, slender and has the shape

of a stick (Fig. 1). In the growth of the cephalont, the top of the epimerite becomes flat, and four finger-like processes grow out symmetrically from the periphery of the top of the epimerite (Fig. 2). In this stage, the epimerite still lies in an epithelial cell of the intestinal canal (Fig. 2). Afterwards, in company with the growth of the cephalont, as the epimerite extricates itself from the epithelial cell, it lies in the epithelial tissue (Figs. 3, 8).

Next, step by step, the epimerite grows in size, and four processes branch off bifurcately; as a result eight processes are protruded (Fig. 9). Lastly, as the eight processes branch off again bifurcately, sixteen finger-like processes are produced (Figs. 10, 11).

(2) Sporont.

(a) Movement. As the cephalont matures, the epimerite becomes detached from the protomerite. The cephalont which has no epimerite is considered to be the sporont (Fig. 4). The sporont is solitary in this stage, and moves forward in a straight line. This gliding motion, accompanied by no bodily contortion, was observed at the rate of about $3-4\mu$ per second. Moreover, in this stage, the protomerite is often retracted into the deutomerite like a cork in the neck of a bottle, and after several seconds' continuation of this retracted state, the sporont instantly regains the normal shape (Fig. 4).

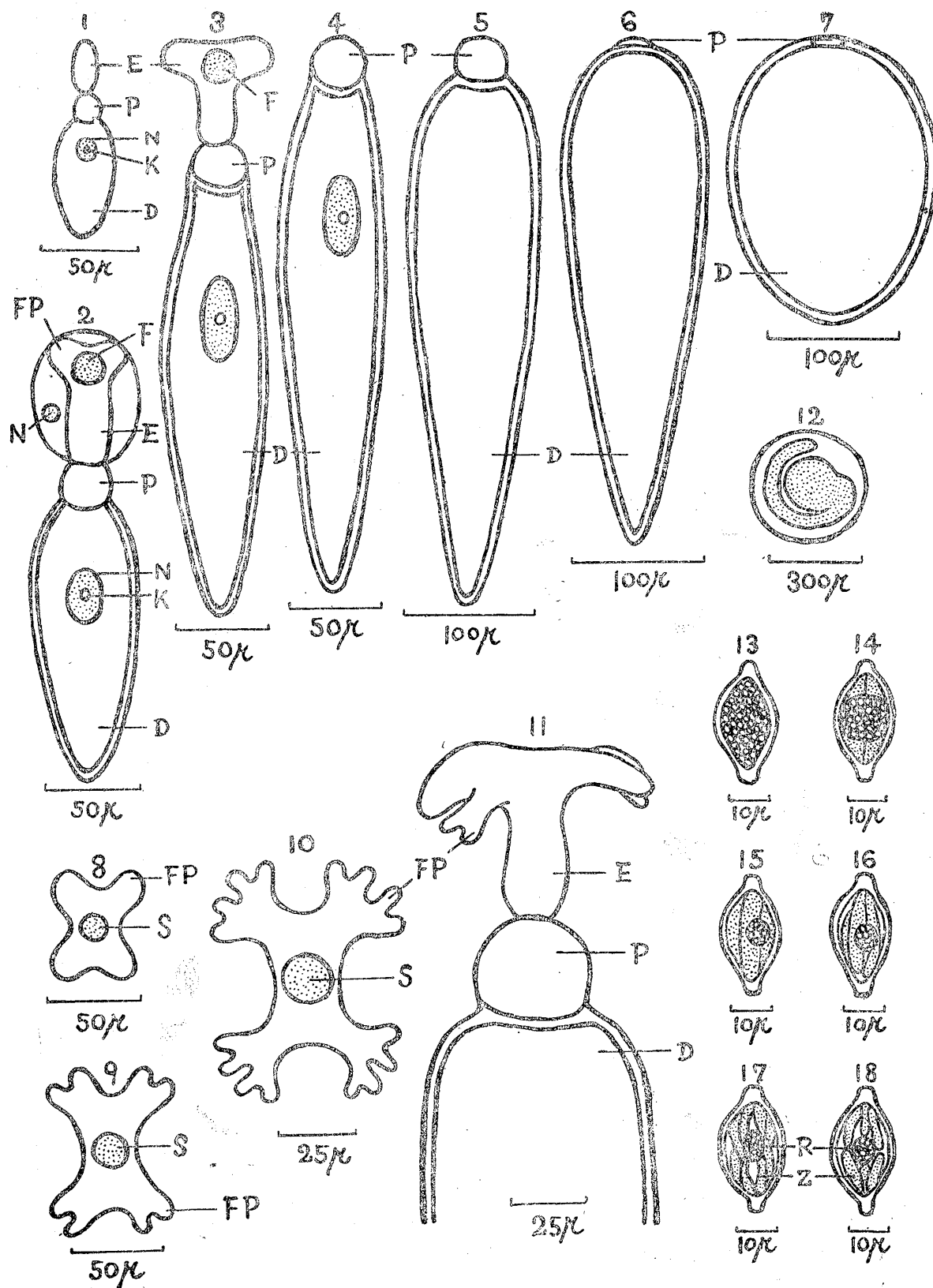
After the sporont has matured adequately (Fig. 5), the protomerite, being drawn almost entirely into the opaque deutomerite, presents an appearance of *Acephalina*'s form (Fig. 6). This sporont does not protrude permanently its protomerite (Fig. 6). In general, the sporonts as those of the *Acephalina* form are found abundant and observed frequently.

(b) Protomerite. Protomerite is globular and light-yellow. In general, a stratum which contains many yellowish green granules is observed in the posterior part of the protomerite.

(c) Deutomerite. In the matured sporont, the ectoplasm of deutomerite is fairly thick measuring about 5μ in thickness. Deutomerite is elongate-cylindrical, dark yellowish brown and ends in a narrowly rounded extremity (Figs. 5, 6). Without longitudinal striations in the deutomerite's epicyte.

(3) Nucleus and karyosome.

In the early stage of cephalont, nucleus is spherical (Fig. 1), but becomes ellipsoidal in its later stages (Figs. 2, 3) and ellipsoidal nucleus is seen also in the early stage of sporont (Fig. 4). In the fully matured sporont, as the deutomerite becomes opaque, the nucleus is unable to be found (Figs. 5, 6, 7). Karyosome is always spherical (Figs. 1-4).



(4) Cyst and sporoblast.

Before the pseudoconjugation, the posterior end of the matured sporonts are usually rounded (Fig. 7).

In the early stage of the encystment, it is observed that a gamont is surrounded incompletely by the other gamont (Fig. 12). Cyst is spherical. Matured cyst dehiscence naturally by simple rupture. Without sporoduct.

Sporoblast biconical (Figs. 13-18). At first, the sporoblast has many light yellowish green granules in it (Fig. 13), but as a result of the cell divisions of three times, matured sporoblast contains eight slender sporozoites in it. That is to say, in one sporoblast, by first longitudinal cell division the two cells are produced (Fig. 14), and by second longitudinal cell division the four cells are produced (Figs. 15, 16), and by third transverse cell division the eight slender sporozoites are produced (Figs. 17, 18).

There is a residual body in the center of the matured sporoblast, and it contains many light yellowish green granules (Figs. 17, 18).

(5) Measurements and ratio.

Measurements:

Large cephalont.

	Length	Width
Epimerite	72.5 μ	20 μ (stalk)
Protomerite	32.5 μ	36 μ
Deutomerite	390.0 μ	100 μ
Total length of sporont	495.0 μ	

Length of deutomerite attains rarely to 850 μ .

Fig. 1. Cephalont with a stick-like epimerite. Nucleus spherical. Fig. 2. Top of epimerite, branched off four finger-like processes. Epimerite lies in one cell. Fig. 3. Epimerite with four processes. With ellipsoidal nucleus. Fig. 4. Sporont. Without epimerite. Nucleus ellipsoidal. Fig. 5. Matured sporont, deutomerite opaque, nucleus not recognizable. Fig. 6. Protomerite is drawn into deutomerite. This sporont presents an appearance of *Acephalina*'s form. Fig. 7. Before pseudoconjugation, the posterior end of the matured sporonts are rounded. Fig. 8. Under view of an epimerite, with four finger-like processes. Fig. 9. Ditto, with eight finger-like processes. Fig. 10. Ditto, with sixteen finger-like processes. Fig. 11. Lateral view of the anterior part of the cephalont, with sixteen finger-like processes. Fig. 12. Cyst. A gamont is surrounded incompletely by other gamont. Fig. 13. Biconical sporoblast, with many light yellowish green granules. Fig. 14. After first longitudinal cell division. Two cells are seen. Figs. 15, 16. After second longitudinal cell division. Four cells are seen. Figs. 17, 18. Mature sporoblast, with eight slender sporozoites and a residual body. E Epimerite, P Protomerite, D Deutomerite, N Nucleus, K Karyosome, Z Sporozoite, R Residual body, FP Finger-like process, S Transverse view of upper part of an epimerite's stalk. F Transverse view of a finger-like process of an epimerite.

	Diameter
Nucleus	62 μ (long axis) 40 μ (short axis)
Karyosome	15.0 μ

Ratio of cephalont:

Length epimerite	:	Total length of sporont	::	1 : 6.8
Length protomerite	:	Total length of sporont	::	1 : 15.2
Length protomerite	:	Length deutomerite	::	1 : 12.0
Length protomerite	:	Length epimerite	::	1 : 2.2
Length epimerite	:	Length deutomerite	::	1 : 5.3
Width protomerite	:	Width deutomerite	::	1 : 2.7
Length protomerite	:	Width protomerite	::	1 : 1.1

The others:

- (1) Diameter of cyst is about 230–330 μ . This diameter contains the thickness of cyst-wall. Thickness of cyst-wall is about 20–25 μ .
- (2) Diameter of sporoblast: Long axis, 26 μ . Short axis, 13 μ .
- (3) Length of sporozoite: Length, about 12 μ . Width, about 2.5 μ .
- (6) Habitat, infection and locality.
 - (a) Habitat and infection: This gregarine is parasitic chiefly in the posterior part of the alimentary canal of *Otocryptops rubiginosus* Koch. Infection common, but rarely not infected.
 - (b) Locality of hosts: Hukuoka Prefecture in Japan, i.e., Hukuoka City, Orio Town, Sawara District and Onga District.

SYSTEMATIC POSITION

In Cephalina Delage 1896, the gregarines which are parasitic in Chilopoda belong to the following four families, having the following characteristics.

- (a) Actinocephalidae Léger, 1892. Characteristics: Epimerite, complex, symmetrical.
- (b) Dactylophoridae Léger, 1892. Characteristics: Epimerite, highly complex, asymmetric, digitate.
- (c) Gregarinidae Labbé, 1899. Characteristics: Epimerite, simple, symmetrical.
- (d) Stenophoridae (Léger and Duboscq, 1904) Pinto, 1918. Characteristics: Epimerite, absent or rudimentary.

As the epimerite of this gregarine parasitic in *Otocryptops rubiginosus* Koch is complex and symmetrical in general, this gregarine belongs to Actinocephalidae. Moreover, this gregarine belongs not to Acanthosporidae Léger, 1892 in Cephalina Delage 1896, for the epimerite of this family is simple, conical knob, globular or subglobular.

As this gregarine has the following four characteristics, it belongs to genus *Hoplorhynchus* Carus 1863 in the twenty-one genera of Actinocephalidae.

- (a) Sporont, slender and with ellipsoidal nucleus.
- (b) Epimerite has a long stalk and the periphery of the flattened top of epimerite has sixteen finger-like processes which branch off bifurcately.
- (c) Cyst, without sporoduct and dehisces by simple rupture.
- (d) Sporoblast biconical.

At present, the following three species are known in genus *Hoplorhynchus* Carus, 1863, and the chief characteristics of these three species necessary to compare with the characteristics of this species are as follows:

- (1) *H. oligacanthus* (von Siebold, 1839) Schneider, 1875.
Characteristics: Epimerite a corona of six to eight slightly recurved hooks set upon a long slender cylindrical neck. Nucleus elongate-cylindrical with many small karyosomes.
- (2) *H. actinotus* (Leidy, 1889) Crawley, 1903.
Characteristics: Epimerite 80 to 100 μ long, vase shaped, broadest near base and tapering to a neck where it again widens into a broad disc of short digitiform processes from 8 to 20 in number.
- (3) *H. scolopendras* Crawley, 1903.
Characteristics: This species is placed in the genus *Hoplorhynchus* on account of its close resemblance to *H. actinotus*. The epicyte of this species is plainly marked with longitudinal striations.

But, as this cephaline gregarine parasitic in *Otocryptops rubiginosus* Koch has the following conspicuous characteristics, I shall call this gregarine by the name of *Hoplorhynchus ozakii* sp. nov.

- (a) In the early stage, the epimerite is simple, slender and has the shape of a stick. But in the growth of cephalont, the periphery of the flattened top of epimerite branches off bifurcately, and at first, it produces four, secondly, eight and lastly, sixteen finger-like processes.
- (b) The epicyte of the deutomerite has no longitudinal striations.

DIAGNOSIS

Hoplorhynchus ozakii sp. nov.

In adult stage, epimerite has a long stalk, periphery of the flattened top of it with sixteen bifurcated finger-like processes. Protomerite

globular, light-yellow. Mature sporont bears an appearance of Acephaline form, the protomerite being drawn almost entirely into the opaque deutomerite. In mature sporont, deutomerite elongate-cylindrical, dark yellowish brown, with a narrowly rounded extremity. Epicyte of deutomerite without longitudinal striations.

Cyst spherical (diameter $230-330\mu$), dehisces by simple rupture, without sporoduct. Sporoblast biconical ($26\mu \times 13\mu$), contains eight slender sporozoites ($12\mu \times 2.5\mu$) and a residual body.

Habitat: Alimentary canal of *Otocryptops rubiginosus* Koch.

Locality of hosts: Hukuoka Prefecture in Japan.

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